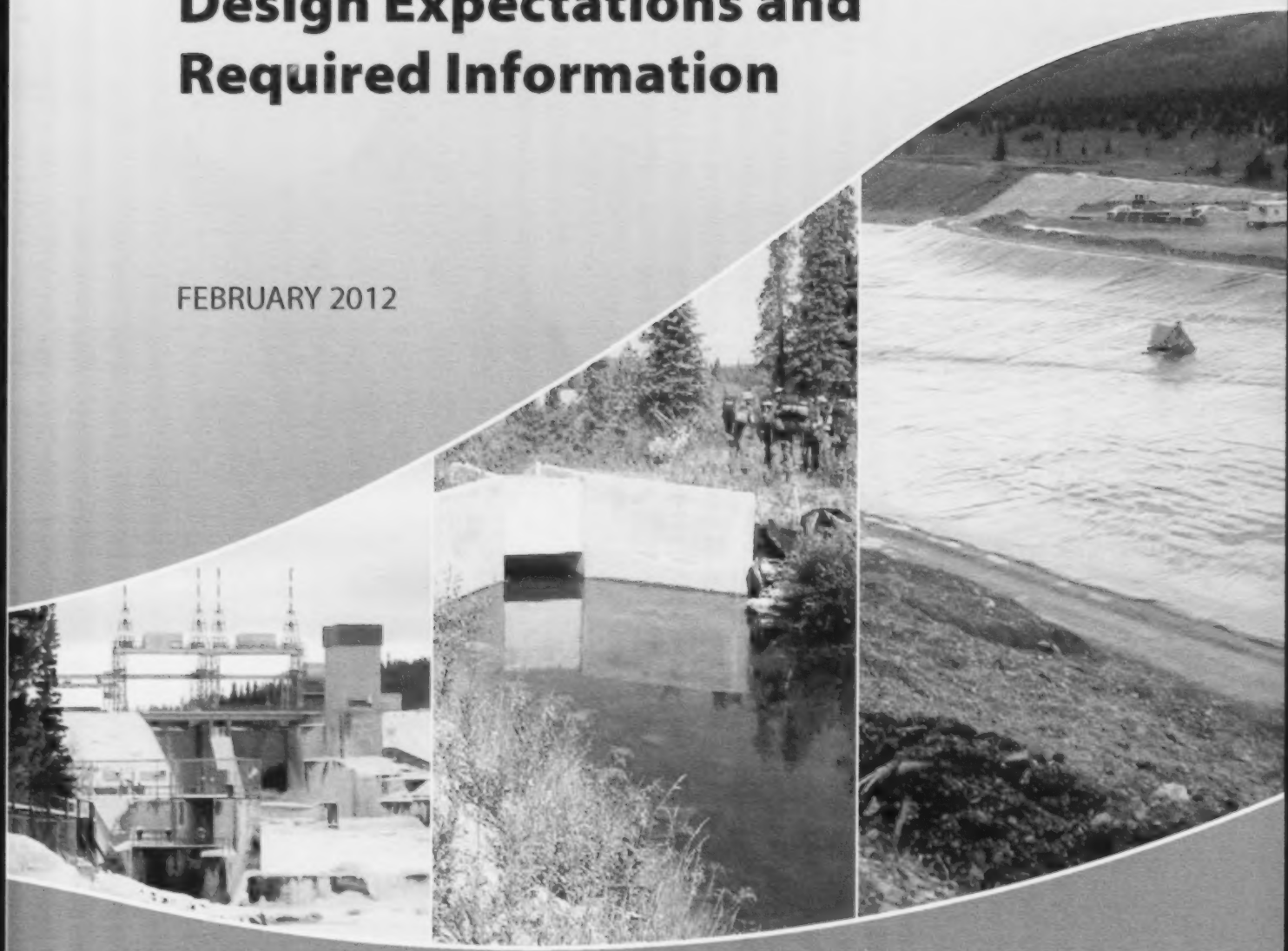
Dam Guide

Design Expectations and Required Information

FEBRUARY 2012



YESAB Yukon Environmental and Socio-economic Assessment Board

Yukon Environment

DAM GUIDE: DESIGN EXPECTATIONS AND REQUIRED INFORMATION

INTRODUCTION

Often projects require the diversion, storage and/or management of water involving the construction of a dam or other water control structure, such as berms or conveyance ditches. It is essential that water storage and conveyance structures be properly built and maintained. Structural failure can cause severe damage to the environment and may result in loss of life.

This guide refers primarily to 'dams' but applies to any water control structure.

Most projects require proponents to submit a project proposal prior to undertaking any work for the purposes of environmental and socio-economic assessment and/or regulatory licensing. This guide has been jointly prepared by the Yukon government (YG) and the Yukon Environmental and Socio-economic Assessment Board (YESAB) and describes the design expectations and supporting information required for dam or water control structures that you as a proponent should be prepared to follow. Depending on the specific details of your project, additional information may be required during assessment and/or regulatory processes.

This guide is intended to support, not replace, direct discussions between proponents, assessors and regulators. The following topics are covered:

- General Information
- Assessment and Licensing Processes
- Information Requirements
- Operations and Decommissioning
- Summary

There are two appendices: A summary of *Waters Regulation* provisions concerning dams, and contact information for the organizations mentioned throughout this guide.

GENERAL INFORMATION

Not every dam project triggers the assessment criteria in the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) and/or the licensing criteria in the *Waters Regulation* and *Quartz Mining Act* (see Appendix 1). This guide is specific to dams requiring an assessment and licence but we recommend that all dam proponents consider following it to ensure proper construction, operations and maintenance.

This guide uses the word 'licence' to refer to a mining land use permit, quartz mining licence, and/or water licence.

This guide applies to two types of dams: those which contain water only ('water storage dams') and those which contain mine waste ('tailings dams').

- ***Water storage dams*** are a barrier built across a stream or depression for the purpose of retaining water. Water storage dams are for storing water. Water storage dams have different design criteria from tailings dams.
- ***Tailings dams*** are a structure or structures built for the purpose of storing mine waste and water from the milling process. The design of a tailings dam depends on the type of tailings involved, where they will be stored, and the life expectancy of the dam.

The Yukon Environmental and Socio-economic Assessment Board (YESAB) and regulatory bodies (e.g. Yukon Water Board) apply the latest version of the Canadian Dam Association's (CDA) *Dam Safety Guidelines* for the Consequence of Failure classification, as well as for the design, monitoring and maintenance of dams.

ASSESSMENT AND LICENSING PROCESSES

Proponents seeking authorization for a project that includes the construction, operation and closure of a dam must first submit a **project proposal** to YESAB. Visit YESAB's website and/or contact a YESAB office for more information.

As a proponent, you may also choose to start the process of applying for a licence at this time rather than waiting until YESAB makes its recommendation. You should be aware that a higher level of design may be required by the regulators.

Once the assessment period is complete, YESAB issues a **recommendation**. All documents related to a project's assessment, including the recommendation, can be viewed on and downloaded from YESAB's Online Registry (www.yesab.ca/registry).

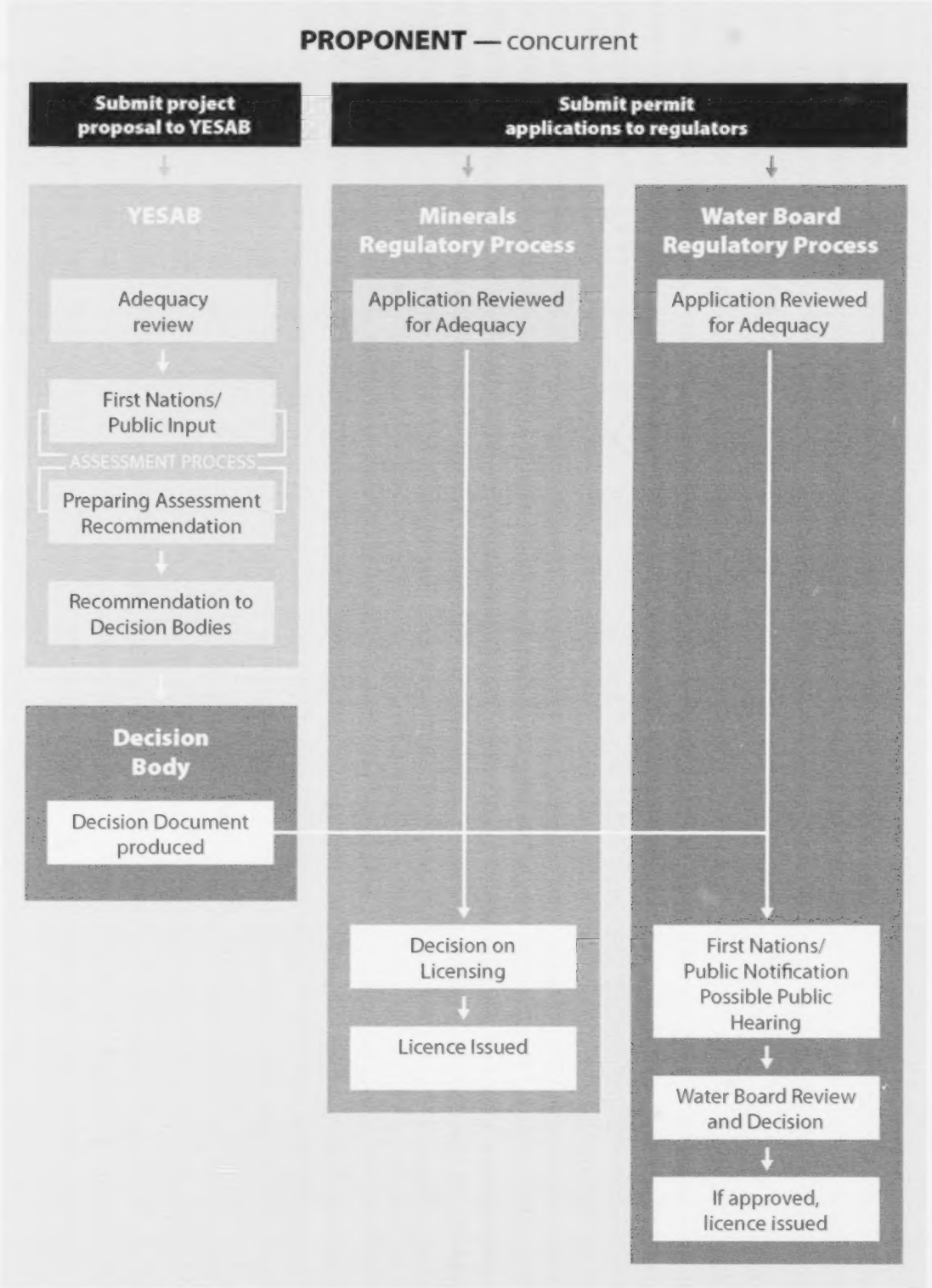
The decision body — usually government — accepts, rejects or varies the recommendation. It issues a **decision document**.

If the decision is to allow a project to proceed, you must then undertake the licencing process. (If you began the licensing process at the same time as the YESAB process, a decision document must be in place before a licence or authorization can be issued.)

The regulatory bodies involved depend on the circumstances. The *Waters Act* requires a water licence for most dams. Dams that are part of a hard rock mining exploration or development project will also be regulated under the *Quartz Mining Act* and will require a mining land use permit and/or a quartz mining licence. Dams that are part of a placer operation are subject to water licensing arrangements pursuant to the *Authorization for Placer Mining Works* or *Undertakings Affecting Fish Habitat*.

You must pay close attention to your licence conditions to ensure you construct or operate only permitted structures. If in doubt, follow up with the regulator(s) involved in your project.

This diagram illustrates how the assessment and licensing processes work together:



INFORMATION REQUIREMENTS

The information required depends on which process is involved. In any of these processes, we encourage proponents to discuss the proposed dam and/or seek clarification with government technical reviewers and regulators prior to submitting information.

1) Assessment Process

Dam proposals need to include information on dam design, baseline information to support the design, and information about the potential environmental and socio-economic effects of the dam. YESAB has materials to help proponents develop adequate project proposals.

Design Information

Generally, a conceptual level of design information is appropriate for the assessment stage. The greater the potential effects/risks of a dam, or effects related to its potential failure, the more detailed the information will need to be. This includes information on:

a) Project location;

b) Site map of dam and reservoir area;

c) Information on the watercourse(s) and watersheds affected by the dam;

d) Size, height, purpose and type of the dam;

e) General design details including dam structure cross-sections, information on foundation soils/ geology/permafrost, and construction materials, etc.;

f) Supporting information for a consequence of failure classification consistent with the *CDA Dam Safety Guidelines* including:

   i. If there is a human population at risk, provide probable maximum flood and probable maximum precipitation and an inundation map showing the maximum extent of flooding related to a sudden full storage dam breach. This mapping should continue downstream until the expected flooding is within the natural channel of the stream(s).

   ii. Assessment of the environmental impacts to aquatic resources and wildlife and their habitat, both in the operational phase of the dam and in the case of a sudden breach.

   iii. Assessment of the impacts to tenured land including First Nations Settlement Lands.

   iv. In the case of a tailings dam, the downstream consequences if there is a release of toxins associated with the material contained behind the dam.

g) Operating parameters for the dam including detailed predictions of volumes and types of material contained behind the dam along with their variability (e.g. water balance);

h) Operating parameters for the release of water from the reservoir;

i) General dam maintenance requirements;

j) Expected lifetime of dam; and

k) Conceptual closure plans for the dam along with specific closure goals.

Environmental and Socio-economic Information

Dam proposals are expected to describe the environmental and socio-economic setting of a dam pre-construction and make defensible predictions for conditions after construction and during operations. This information should include:

a) Upstream and downstream topography, geology, soils, vegetation (including habitat classification), wildlife and aquatic life. Additional detail is required for areas that are expected to be temporary or permanently inundated (e.g. reservoirs);

b) Upstream and downstream land uses including hunting, harvesting, trapping, recreational trails, etc.;

c) Watershed and watercourse information including baseline hydrology (including peak flows and inputs, etc.) and water quality;

d) Regional meteorological information focused on precipitation (amount, type, seasonality/timing); and

e) Baseline precipitation and hydrology should inform detailed water balance modeling with appropriately conservative predictions for minimum and maximum flows.

As a proponent you should collect environmental information relevant to your dam design criteria and should establish environmental monitoring stations for ongoing data collection.

Dam Failure Consequences Information

In order to assess the Consequence of Failure classification described in the *CDA Dam Safety Guidelines*, you will be required to consider and provide information on:

a) Loss of life — demographic and land use factors in the area;

b) Economic losses — third party property, facilities, other utilities and infrastructure;

c) Environmental losses — aquatic and terrestrial life;

d) Cultural losses — damage to irreplaceable historic and cultural features; and

e) Incremental and total consequences.

2) Regulatory Processes

In addition to the information submitted to YESAB as part of the project description, regulatory agencies generally require more detailed design information. You should ensure your licence application includes:

a) Descriptive information carried forward from the project description;

b) A proposed and defensible Consequence of Failure Classification based on the current CDA *Dam Safety Guidelines*;

c) Additional information to address decision document requirements;

d) Type of dam and proposed construction materials (including unique or important design consideration);

e) Assessment and description of site geology, seismicity and geotechnical investigations, including any areas of permafrost;

f) Assessment of the hydrology and climate of the area (including data sources) and a mean annual hydrograph for the dam location. Include expected annual mean and summer mean flows and peak flows for 1:500 and 1:1000 year floods;

g) Conceptual closure plans and (if applicable) ongoing study plans;

h) Detailed description of site conditions and remediation of unusual conditions, e.g. permafrost;

i) Instrumentation;

j) Follow-up field investigation plans to be done before construction;

k) At a minimum preliminary engineering design drawings of the dam, spillway, low level outlet and other features of the dam design with the water licence application, with a commitment to submit detailed engineering design drawings to the regulator prior to construction;

l) Detailed engineering design drawings of the dam, spillway, low level outlet and other features of the dam design with supporting information:

   i. A construction plan that includes: a description of the engineering company that is supervising construction; details about any diversion, dewatering, runoff handling, and potential siltation problems during construction (note how downstream minimum flow requirements will be met); a description of the quality assurance testing program; and a detailed construction schedule.

   ii. An operation, maintenance and surveillance plan consistent with the CDA *Dam Safety Guidelines*.

   iii. An emergency response plan (this is required for all dams with a Consequence of Failure Classification of 'high' or higher). This plan can be included as a section in the operation, maintenance and surveillance plan or a stand-alone document.

   iv. A dam safety review plan.

m) Commitment to submit as-built drawings and any changes to the plans noted in (k) above; and

n) Any other information noted in the CDA *Dam Safety Guidelines*.

Regulators will advise proponents if additional information is required during the **adequacy review** of the licence application. As a proponent you should review the decision document for your project as well to see if you must provide additional information.

If an application does not include construction designs and supporting documents, the regulators will give you a deadline to submit this information. This allows time for the regulators to review and if necessary follow-up with proponents on any issues.

You shall generally be required to submit detailed construction records (compiled by the supervising engineer) to the regulators within 120 days of completion.

Water Use Licence

The Yukon Water Board (YWB) requires preliminary designs.[1] If the YWB approves your application and issues a licence, final design drawings and as-built design drawings will usually need to be provided. The YWB has timelines for submitting these designs and other documents in the conditions of the water use licence.

Quartz Mining Licence

The Chief of Mining Land Use requires a construction plan[1] that includes preliminary designs for review and approval. The quartz mining licence sets a deadline for providing final design drawings and as-built design drawings.

Mining Land Use Permit

The Chief of Mining Land Use requires a construction plan that includes preliminary designs[1] for review and approval. The mining land use permit sets a deadline for providing final design drawings and as-built design drawings.

[1] Design/plan must be sealed by a professional engineer licenced to practice in Yukon.

OPERATIONS AND DECOMMISSIONING

Licence conditions generally require proponents to implement their surveillance and monitoring plans and to report on the results of these plans on a regular basis. As a proponent, you are usually required to have a professional engineer conduct an annual inspection of the structures, then submit the inspection report along with a discussion of actions to be taken to address any issues.

You must immediately report to the regulatory authorities any issues that arise with your structures, as well as actions taken to address the issues.

You should keep detailed records of all monitoring and surveillance activities. An inspector may request to view these records during a field inspection. Licences usually require those records to be submitted on an annual basis.

It is possible for a consequence of failure classification – and thus design requirements – to change after the dam is built and operating. This may be due to changes in downstream development, changes to the material contained behind the dam or changes to the dam structure itself. Depending upon the extent of the changes, a proponent may be required to apply for a licence amendment and may also be subject to a re-assessment by YESAB.

The licence usually requires a proponent to have an approved abandonment and reclamation plan prior to temporarily or permanently decommissioning a dam. Proponents are usually required to give notice prior to temporarily or permanently decommissioning a dam.

SUMMARY

This guide describes the assessment and regulatory processes at a high level. It sets out the information required in order to assess conceptual design, environmental and socio-economic impacts and consequence of failure. It also sets out the additional information required by regulators in order to issue a water licence, quartz mining licence or mining land use permit.

We encourage you to contact YESAB and the regulators directly to discuss the process and/or clarify details. In the event of a conflict between the information contained in this guide and the applicable legislation/regulation, the latter shall prevail.

APPENDIX 1:

Waters Regulation provisions concerning dams

Correct as of February 2012

There are two types of water licence:

- Type "A" licences are for major undertakings and require a public hearing, and
- Type "B" licences might require a public hearing, as determined by the Yukon Water Board.

The following schedules are from the *Waters Regulation* of the Yukon *Waters Act*. They set out whether or not a dam requires a licence and if so, which kind. The *Act* and *Regulation* are available on the Government of Yukon website.

Schedule 5 — Industrial Undertakings

Permitted without a Licence	None.
"B" Water Licence Required	Construction of a dam the maximum height of which is less than 8 metres or where less than 60,000 cubic metres of water is stored and no hazard is posed.
"A" Licence Required	Construction of a dam the maximum height of which is 8 metres or higher or where 60,000 cubic metres or more of water is stored or a hazard is posed.

Schedule 6 — Placer Mining Undertakings

Permitted without a Licence	None.
"B" Water Licence Required	Any alteration of flow or storage
"A" Licence Required	None.

Schedule 7 — Quartz Mining Undertaking

Permitted without a Licence	Construction of a dam the maximum height of which is less than 3 m where less than 10,000 cubic metres of water is stored and no hazard is posed.
"B" Water Licence Required	Construction of a dam the maximum height of which is 3 or more metres but less than 8 m and no hazard is posed, or where 10,000 or more cubic metres of water but less than 60,000 cubic metres of water is stored and no hazard is posed.
"A" Licence Required	Construction of a dam the maximum height of which is 8 m or higher, where 60,000 or more cubic metres of water is stored or where a hazard is posed.

Schedule 8 — Municipal Undertakings

Schedule 9 — Power Undertakings

Schedule 10 — Agricultural, Conservation, Recreational and Miscellaneous Undertakings

The conditions are the same for all three Schedules

Permitted without a Licence	None.
"B" Water Licence Required	Construction of a dam the maximum height of which is less than 8 metres and no hazard is posed or where less than 60,000 cubic metres of water is stored and no hazard is posed.
"A" Licence Required	Construction of a dam the maximum height of which is 8 metres or more, where 60,000 or more cubic metres of water is stored or where a hazard is posed.

APPENDIX 2:

Contact Information

Correct as of February 2012

Yukon Environmental and Socio-economic Assessment Board
www.yesab.ca
Head Office: 200-309 Strickland Street, Whitehorse, Yukon Y1A 2J9
Telephone: 867-668-6420 (toll free 1-866-322-4040)
Use the web site to find Designated Office contact information and the YESAB Online Registry

Yukon Water Board
www.yukonwaterboard.ca
106-419 Range Road, Whitehorse, Yukon Y1A 3V1
Telephone: 867-456-3980
Waters Act licensing

Water Resources Branch (Environment Yukon)
www.env.gov.yk.ca
Mailing Address: Box 2703 (V-310), Whitehorse, Yukon Y1A 2C6
Street Address: Room 310, 300 Main Street, Whitehorse, Yukon
Telephone: 867-667-3171 (toll free 1-800-661-0408 X3171)
Waters Act enforcement, technical information on water quality, hydrology, and geotechnical

Minerals Branch (Government of Yukon, Energy, Mines and Resources)
www.emr.gov.yk.ca/mining
Mailing Address: Box 2703 (K-9), Whitehorse, Yukon Y1A 2C6
Street Address: 400-211 Main Street, Whitehorse, Yukon
Telephone: 867-633-7952 (toll free 1-800-661-0408 X7952)
Quartz Mining Act administration, technical

Client Services and Inspections Branch (Government of Yukon, Energy, Mines and Resources)
www.emr.gov.yk.ca/csi
Mailing Address: Box 2703 (K-325), Whitehorse, Yukon Y1A 2C6
Street Address: 325-300 Main Street, Whitehorse, Yukon
Telephone: 867-667-3137 (toll free 1-800-661-0408 X3137)
Quartz Mining Act enforcement

Canadian Dam Association
www.cda.ca
P.O. Box 2281, Moose Jaw, Saskatchewan S6H 7W6
Telephone: 306-631-0671
Dam Safety Guidelines